an outer portion of the circular chamber having a varying cross sectional area, wherein the cross section area of the outer portion of the chamber is greatest at a position diametrically opposed to the position of the fluid outlet aperture.

REMARKS

Claims 1-22, 29-31, and 35-46 will be pending upon entry of the present amendment. Claims 1, 18, 21, 29 and 35 are amended, claims 5 and 32-34 are cancelled, and claims 43-46 are added.

Applicants thank the Examiner for indicating claims 12-14, 16 and 34 as having allowable subject matter. Accordingly, claims 44-47 are submitted incorporating the allowable subject matter from claims 12-14 and 16 together with the necessary antecedent matter.

The Examiner has objected to the drawings under 37 C.F.R. § 1.83(a), as failing to show the laterally straight fin claimed in claim 5. Accordingly, claim 5 is cancelled.

The Examiner has rejected claims 21 and 22 under 35 U.S.C. § 112, second paragraph, as being indefinite. Accordingly, claim 21 is amended to depend from claim 20.

The Examiner has rejected claims 1 and 4 under 35 U.S.C. § 102(b) as being anticipated by Schmidt. Claims 1-2, 15, 17, 29-30, 36 and 38-41 were rejected under 35 U.S.C. § 102(b) as being anticipated by Engel et al. The Examiner rejected claims 1-4, 6, 17-22, 29-33 and 35-42 under 35 U.S.C. § 102(b) as being anticipated by Turner. The Examiner rejected claims 1-4, 6-9, 15 and 17-19 under 35 U.S.C. § 102(b) as being anticipated by Opitz et al. Claims 1-2, 4, 10, 17-18, 29-30, 36 and 38-42 were rejected under 35 U.S.C. § 102(b) as being anticipated by Little. The Examiner also rejected claims 1-2, 15, 29-30, 36 and 38-42 under 35 U.S.C. § 102(b) as being anticipated by Iversen et al.

With respect to the rejections of claim 1, claim 1 has been amended to include the recitation a "semiconductor chip." This amendment of claim 1 distinguishes claim 1 over the teachings of Schmidt, Engel et al. and Turner, inasmuch as each of these references is directed to the cooling of devices or materials that are not directly associated with semiconductor chips. With respect to the reference of Opitz et al., Opitz et al. fails to teach a fluid inlet aperture positioned at a central portion of the circular chamber and a fluid outlet aperture positioned at a peripheral region of the circular chamber. Rather, Opitz et al. teaches introduction of cooling fluids into the flow chamber by the distributor, which is located at the periphery of the device

where it flows toward the central discharge at the center of the device and is carried away (col. 2, l. 63 - col. 3, l. 2). The direction of flow of the fluids according to Opitz et al. is not arbitrary and cannot be reversed, inasmuch as the control of fluid velocity depends upon the flow from the perimeter to the center. Thus, Opitz et al. neither suggests nor anticipates the device according to claim 1. Claim 1 is therefore allowable over Opitz et al.

With respect to the rejection of claim 1 over Little, Little fails to teach a fluid inlet or a fluid outlet, but rather teaches the use of capillary channels for the introduction of *gaseous* refrigerants. Little's device is designed to employ gaseous refrigerants and would be ineffective if it were to be converted to the use of fluid refrigerants. It is well known in the art that gaseous refrigerants depend upon the sudden expansion of the gas to absorb heat, and the device as taught by Little takes advantage of this principle. The use of fluids in this device would be ineffective inasmuch as the expansion of the fluids, which would occur, given the geometry of the device, would tend to slow down the velocity of the fluid and therefore reduce its ability to absorb heat and thus this device is not acceptable as a fluid cooling device, and does not anticipate or suggest the heat exchanger of claim 1. Claim 1 is therefore allowable over Little.

With respect to rejection of claim 1 over Iversen, while Iversen does make mention of a device for cooling semiconductor materials or devices, Iversen fails to enable such an application. Rather, the teachings of Iversen are directed toward the use of a liquid cooled rotating anode x-ray tube. With reference to Figures 5 and 6 of Iversen and the text beginning at line 43 of column 3 thereof, we learn that "the heat transfer surface 20 commences where fins 76 and 81 are substantially fully developed 84." Now with reference to Figure 7, we can see that the heat transfer fins designated by reference number 28 are found at an outer edge of the device and below the plane of its upper surface. The location of these fins corresponds with the x-ray tube anode focal track surface 86 which is shown in Figure 7, and which is the region where heat is present to be dissipated in this particular device. An examination of Figure 7 and 8 indicates that this smooth region 86 has a frusto conical shape, which is appropriate for its application in x-ray technology, but would be inappropriate for the cooling of a semiconductor device. Cooling fins are not taught or provided by Iversen in the flat upper region of the device, nor would it be obvious to place them there inasmuch as Iversen teaches the benefits of the fins being in a curved section as shown in Figure 1. Therefore, the Iversen device, as taught, cannot be used to cool a semiconductor chip, and therefore does not anticipate claim 1.

For at least the reasons listed above claim 1 is allowable over all the prior art cited by the Examiner. Claims 2-17, being dependent on claim 1, are also allowable.

Claim 10 is allowable on its own merits, inasmuch as none of the references cited by the Examiner teach two concentric circular arrays comprising an inner array and an outer array of cooling fins, each of the arrays comprising a plurality of fins arranged in a generally radial pattern with each fin extending from a leading edge of the fin to a trailing edge of the fin, the trailing edge being positioned radially outward of the leading edge closer to a peripheral region of the circular chamber. The Examiner has cited Little as anticipating claim 10; however, there is no teaching in Little which suggests the employment of concentric arrays of cooling fins. Claim 10 is therefore allowable over the cited prior art.

With respect to the rejection of claim 18, claim 18 has been amended as follows: The preamble has been amended to read "a heat exchanger for cooling a device." The second element has been amended to read "a fin plate in contact with the heat conducting surface, and having two concentric circular arrays of fins, comprising an inner array and an outer array, each circular array comprising a plurality of fins arranged in a generally radial pattern, extending outward from an inner region of the respective array toward an outer region thereof." The Examiner has cited Turner, Opitz et al. and Little as anticipating claim 18. With the amendment of the second element, claim 18 is now in condition for allowance over the cited prior art including Little for at least the reasons stated with reference to the allowability of claim 10. Claims 19-22, as dependent claims on claim 18 are also in condition for allowance.

With reference to the rejection of claim 29, claim 29 has been amended to include the allowable matter from claim 34, together with the matter from the intervening claims. Claim 29 is therefore in condition for allowance. Claims 32-34 are cancelled, and claim 35 is amended to depend from claim 31. Claims 30, 31 and 35-42 are now in condition for allowance.

The Examiner has rejected claims 5 and 10-11 under 35 U.S.C. § 103(a) as being unpatentable over Opitz et al. in view of Kodama et al. The Examiner has also rejected claim 11 under 35 U.S.C. § 103(a) as being unpatentable over Little in view of Kodama et al.

With respect to the rejection of claims 5 and 10-11, the Examiner has commented that Opitz et al. discloses all the claimed limitations except straight fins. Applicants observe that Opitz et al. does not teach concentric circular arrays as claimed in claim 10, and thus the combination of Opitz et al. and Kodama et al. does not anticipate or suggest claim 10. With

respect to the other rejections under 35 U.S.C. § 103(a), those rejections are moot inasmuch as the rejected claims are dependent claims, depending on allowable independent claims.

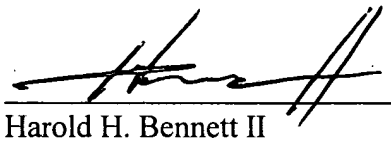
Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version With Markings to Show Changes Made.**"

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,

Wade J. Doll

SEED Intellectual Property Law Group PLLC



Harold H. Bennett II
Registration No. P-52,404

HHB:wt

Enclosure:
Postcard
Form PTO/SB/21
Form PTO/SB/17

701 Fifth Avenue, Suite 6300
Seattle, Washington 98104-7092
Phone: (206) 622-4900
Fax: (206) 682-6031

D:\NRPORTBL\IMANAGE\VICTORIAS\272556_1.DOC

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

1. (Amended) A heat exchanger, assembly ~~for a semiconductor chip~~ comprising:

a semiconductor chip;

a heat conducting surface positioned adjacent said semiconductor chip;

a circular chamber positioned above the heat conducting surface;

a plurality of heat conducting fins disposed within the circular chamber;

a fluid inlet aperture positioned at a central portion of the of the circular chamber; and

a fluid outlet aperture positioned at a peripheral region of the circular chamber.

~~5. The heat exchanger of claim 3 wherein each fin extends laterally from a leading edge to a trailing edge with the trailing edge being closer to the peripheral portion of the circular chamber, and the fin being laterally straight.~~

18. (Amended) A heat exchanger for ~~a semiconductor chip~~cooling a device, comprising:

a heat conducting surface;

a fin plate in contact with the heat conducting surface, and having two concentric circular arrays of fins, comprising an inner array and an outer array, each circular array comprising a plurality ~~an array~~ of fins arranged in a generally radial pattern, extending outward from an ~~central~~ inner region of the ~~plate~~ respective array toward ~~a peripheral~~an outer region ~~of the plate~~thereof;

an annular wall extending upwardly from the fin plate;

an overhead wall with a recessed annular channel, the overhead wall, the fin plate and the annular wall defining a fluid chamber of the heat exchanger;

a fluid inlet aperture disposed at the center of the overhead wall; and

a fluid outlet aperture disposed at the periphery of the overhead wall.

21. (Amended) The heat exchanger of claim ~~19~~ 20 wherein the conduit chamber is a cylinder.

29. (Amended) A method for cooling a semiconductor chip comprising:

impacting a cooling fluid against the central region of a plate within a circular chamber;

distributing the fluid through the chamber;

withdrawing heat from the semiconductor through the plate and into the fluid; and

discharging the fluid through an outlet aperture located at a peripheral portion of the circular chamber

attaining even distribution of the fluid throughout the circular chamber as it flows towards the periphery of the chamber by equalizing pressure drop for substantially equal flows rates, from the center of the plate, in any radial direction, to the fluid outlet aperture of the chamber, by varying the fluid velocity of the fluid about the periphery of the circular chamber, and by comprises increasing the fluid velocity as it approaches the fluid outlet aperture.

~~32. The method of claim 31 further comprising attaining even distribution of the fluid throughout the circular chamber as it flows towards the periphery of the chamber by equalizing pressure drop for substantially equal flows rates, from the center of the plate, in any radial direction, to the fluid outlet aperture of the chamber.~~

~~33. The method of claim 32 wherein equalizing the pressure drop from the center of the plate to the outlet aperture comprises varying the fluid velocity of the fluid about the periphery of the circular chamber.~~

~~34. The method of claim 33 wherein varying the fluid velocity about the periphery of the circular chamber further comprises increasing the fluid velocity as it approaches the fluid outlet aperture.~~

35. (Amended) The method according to claim ~~32~~ 31 wherein equalizing the pressure drop comprises varying the cross sectional area of an outer portion of the circular chamber.

43. (New) A heat exchanger for a semiconductor chip comprising:

a heat conducting surface;

a circular chamber positioned above the heat conducting surface;

a fluid inlet aperture in the circular chamber;

a fluid outlet aperture in the circular chamber.

a plurality of heat conducting fins disposed within the circular chamber and arranged in at least two concentric circular arrays, comprising at least an inner array and at least an outer array, each circular array comprising a plurality of fins arranged in a generally radial pattern with each fin extending from a leading edge of the fin to a trailing edge of the fin, the trailing edge being positioned radially outward of the leading edge closer to a peripheral region of the circular chamber; and

wherein the circular chamber has two annular space regions, with a first annular space being between the inner array and outer array of fins, and a second annular space being between the outer array of fins and an inside surface of an annular wall of the chamber.

44. (New) The heat exchanger according to claim 43 wherein an overhead wall of the circular chamber has at least one annular fluid channel recessed upwardly into the wall, the annular fluid channel being disposed over at least one of the annular space regions in the circular chamber.

45. (New) The heat exchanger according to claim 43 wherein an overhead wall of the circular chamber has an annular fluid channel recessed upwardly into the wall and having a varying cross sectional area, the cross sectional area being greatest at a distance along the channel furthest from the fluid outlet aperture and at a minimum adjacent the fluid outlet aperture, the annular fluid channel being disposed over at least one of the annular space regions in the circular chamber.

46. (New) A heat exchanger for a semiconductor chip comprising:

a heat conducting surface;

a circular chamber positioned above the heat conducting surface;

a fluid inlet aperture positioned at a central portion of the of the circular chamber; and

a fluid outlet aperture positioned at a peripheral region of the circular chamber; and

an outer portion of the circular chamber having a varying cross sectional area, wherein the cross section area of the outer portion of the chamber is greatest at a position diametrically opposed to the position of the fluid outlet aperture.